

Industrial Safety and Environment Management

Safety: A measure of the degree of freedom from risk or conditions that can cause death, physical harm, or equipment or property damage.

System Safety Process: The system in which free from unacceptable risk of harm or damage.

System safety precedence: an ordered listing of preferred methods of eliminating or controlling hazards.

Hazard: a condition or situation that exists within the working environment capable of causing harm, injury, and/or damage.

Hazard severity: a categorical description of hazard level based on real or perceived potential for causing harm, injury, and/or damage.

Hazard probability: the likelihood that a condition or set of conditions will exist in a given situation or operating environment.

Mishap: an occurrence that results in injury, damage, or both.

Near-miss: an occurrence that could have resulted in injury, damage, or both, but did not.

Risk: the likelihood or possibility of hazard consequences in terms of severity and probability.

Accident: undesired circumstances which give rise to ill-health or injury, damage to property, plant, products or the environment; production losses or increased liabilities.

Incident: undesired circumstances and near-miss which could cause accidents.

Physical Hazards

During work activities could the following hazards exist?

- slips/falls on the level,
- fire and explosion,
- substances that may be inhaled or agents that may damage the eye or absorbed through the skin or ingested (i.e., entering the body via the mouth),

Health Hazards

- negative stress (e.g. from poor work organization or control, repetitive strain, etc)
- noise (e.g. if people must raise their voices to be heard)
- harmful dusts (e.g. from grinding)
- unsuitable lighting levels

Chemical Hazards

To identify chemical hazards and assess their risks, you need data on at least the following:

- Immediate problems, (e.g. acute toxic effects or catching fire)
- Long-term effects of exposure on health (e.g. cancer-causing)
- Likelihood of explosion, skin problems and chest problems

Biological Agent Hazards

These include viruses and bacteria that can cause infection and substances from plants or animals that can lead to health problems.

Human-factor Hazards

- People should be mentally and physically capable of doing their jobs safely.
- The workplace, the work system, the organization of work and the job should be designed so as to avoid causing sustained stress

➤ Hazard Severity

The hazard severity categories listed in Table 1 provide a qualitative indication of the relative severity of the possible consequences of the hazardous condition(s).

Table 1: Hazard safety categories

Description	Category	Mishap Identification
Catastrophic	I	Death or system loss
Critical	II	Severe injury, occupational illness, or system damage
Marginal	III	Minor injury, occupational illness, or system damage
Negligible = Safe	IV	Less than minor injury, occupational illness, or system damage

Hazard probability

Represent a qualitative judgment on the relative likelihood of occurrence of a mishap caused by the uncorrected or uncontrolled hazard.

Table 2: Hazard probability levels

Description	Level	Mishap Identification
Frequent	A	Likely to occur frequently
Probable	B	Will occur several times during life of an item
Occasional	C	Likely to occur sometime during life of an item
Remote	D	Unlikely, but may possibly occur during life of an item
Improbable	E	So unlikely that the hazard can be assumed not to occur

The Hazard Risk Matrix

Provide an effective tool for approximating acceptable and unacceptable levels or degrees of risk.

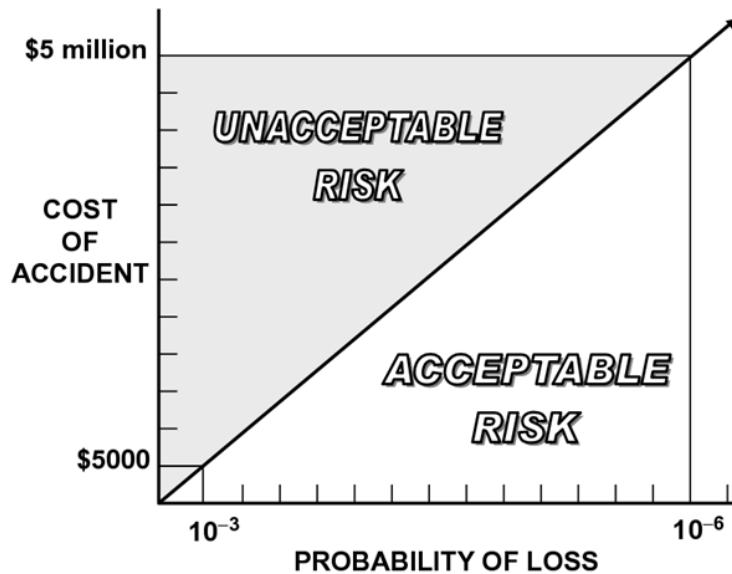
Table 3: risk assessment matrix

Frequency of Occurrence	Hazard Categories			
	I Catastrophic	II Critical	III Marginal	IV Negligible
(A) Frequent	1A	2A	3A	4A
(B) Probable	1B	2B	3B	4B
(C) Occasional	1C	2C	3C	4C
(D) Remote	1D	2D	3D	4D
(E) Improbable	1E	2E	3E	4E

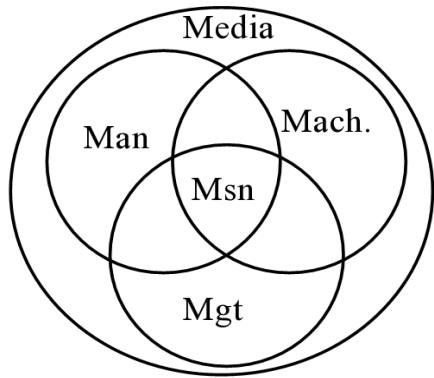
Hazard Risk Index	
Risk Classification	Risk Criteria
1A, 1B, 1C, 2A, 2B, 3A	Unacceptable; changes must be made
1D, 2C, 2D, 3B, 3C	Undesirable; make changes if possible
1E, 2E, 3D, 3E, 4A, 4B	Acceptable with management review
4C, 4D, 4E	Acceptable without review

Cost & Risk Acceptance

Figure 1 is a graphic illustration model of an expected loss index based on cost of system loss versus the probability of that loss.

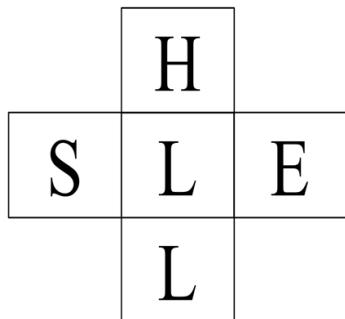


5M model of System Engineering



- **Msn** - Mission: central purpose or functions
- **Man** - Human element
- **Mach.** - Machine: hardware and software
- **Media** - Environment :ambient and operational environment
- **Mgt** - Management :procedures, policies, and regulations

SHELL Model of a system



- S**= Software (procedures, etc.)
H= Hardware (machine)
E= Environment (operational and ambient)
L= Liveware (human element)

Occupational Safety and Health?

is a discipline with a broad scope involving many specialized fields.

In its broadest sense, it should aim at:

- the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations;
- the prevention of workers of adverse effects on health caused by their working conditions;
- the placing and maintenance of workers in an occupational environment adapted to physical and mental needs;

Cost of occupational disease or accident

For workers → direct costs are:

- ✓ the pain and suffering of the injury or illness;
- ✓ the loss of income;
- ✓ the possible loss of a job;
- ✓ health-care costs.

For workers → indirect costs of an accident or illness can be four to ten times greater than the direct costs, or even more.

For employers → direct costs are:

- payment for work not performed;
- medical and compensation payments;
- repair or replacement of damaged machinery and equipment;
- reduction or a temporary stop in production;
- increased training expenses and administration costs;

For employers → indirect costs for employers are:

- ✓ a new worker has to be trained and given time to adjust;
- ✓ it takes time before the new worker is producing at the rate of the original worker;
- ✓ accidents often influence labour relations in a negative way;

On a national scale, the estimated costs of occupational accidents and illnesses can be as high as 3-4 % of a country's gross national product.

Occupational Safety and Health Administration (OSHA)

History

- On December 29, **1970**, President Nixon signed the **OSH Act**
- This Act created **OSHA**, the agency, which formally came into being on April 28, **1971**

OSHA's Mission

- The mission of **OSHA** is to save lives, prevent injuries and protect the health of workers.

OSHA Standards

OSHA standards fall into four categories: General Industry, Construction, Maritime, and Agriculture.

- OSHA issues standards for a wide variety of workplace hazards.
- OSHA is responsible for writing and enforcing standards that employers must follow.
- Where OSHA has not issued specific standards, employers are responsible for following the OSH Act's "General Duty Clause".

workers' responsibilities

- ☒ Read the OSHA poster
- ☒ Follow the employer's safety and health rules and wear or use all required gear and equipment
- ☒ Follow safe work practices for your job, as directed by your employer
- ☒ Report hazardous conditions to a supervisor or safety committee
- ☒ Report hazardous conditions to OSHA, if employers do not fix them
- ☒ Cooperate with OSHA inspectors

Employers' responsibilities

- ❖ Employers must provide a safe and healthful workplace free of recognized hazards and follow the OSHA standards
- ❖ The OSH Act grants employers important rights, particularly during and after an OSHA inspection
- ❖ Employers also provide training, medical examinations and recordkeeping